World Academy of Science, Engineering and Technology
International Journal of Geotechnical and Geological Engineering
Vol:15, No:01, 2021

3D Classification Optimization of Low-Density Airborne Light Detection and Ranging Point Cloud by Parameters Selection

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Abstract : Light detection and ranging (LiDAR) is an active remote sensing technology used for several applications. Airborne LiDAR is becoming an important technology for the acquisition of a highly accurate dense point cloud. A classification of airborne laser scanning (ALS) point cloud is a very important task that still remains a real challenge for many scientists. Support vector machine (SVM) is one of the most used statistical learning algorithms based on kernels. SVM is a non-parametric method, and it is recommended to be used in cases where the data distribution cannot be well modeled by a standard parametric probability density function. Using a kernel, it performs a robust non-linear classification of samples. Often, the data are rarely linearly separable. SVMs are able to map the data into a higher-dimensional space to become linearly separable, which allows performing all the computations in the original space. This is one of the main reasons that SVMs are well suited for high-dimensional classification problems. Only a few training samples, called support vectors, are required. SVM has also shown its potential to cope with uncertainty in data caused by noise and fluctuation, and it is computationally efficient as compared to several other methods. Such properties are particularly suited for remote sensing classification problems and explain their recent adoption. In this poster, the SVM classification of ALS LiDAR data is proposed. Firstly, connected component analysis is applied for clustering the point cloud. Secondly, the resulting clusters are incorporated in the SVM classifier. Radial basic function (RFB) kernel is used due to the few numbers of parameters (C and γ) that needs to be chosen, which decreases the computation time. In order to optimize the classification rates, the parameters selection is explored. It consists to find the parameters (C and γ) leading to the best overall accuracy using grid search and 5-fold cross-validation. The exploited LiDAR point cloud is provided by the German Society for Photogrammetry, Remote Sensing, and Geoinformation. The ALS data used is characterized by a low density (4-6 points/m^2) and is covering an urban area located in residential parts of the city Vaihingen in southern Germany. The class ground and three other classes belonging to roof superstructures are considered, i.e., a total of 4 classes. The training and test sets are selected randomly several times. The obtained results demonstrated that a parameters selection can orient the selection in a restricted interval of (C and γ) that can be further explored but does not systematically lead to the optimal rates. The SVM classifier with hyper-parameters is compared with the most used classifiers in literature for LiDAR data, random forest, AdaBoost, and decision tree. The comparison showed the superiority of the SVM classifier using parameters selection for LiDAR data compared to other classifiers.

Keywords : classification, airborne LiDAR, parameters selection, support vector machine
Conference Title : ICAHGG 2021 : International Conference on Advances in Hydrogeology, Geology and Geotechnics
Conference Location : Rome, Italy
Conference Dates : January 18-19, 2021